

12/12/04

IN THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

1. (Original) A method for estimating carrier frequency and phase offsets of a digitally modulated signal, comprising:

- (a) estimating one or more phases of a sequence of digitally modulated symbols;
- (b) removing from each of the estimated phases an angle rotation introduced by a modulation format, wherein the rotation is determined based on a reference symbol;
- (c) deriving a set of values from the estimated phases after removal of said angle rotation, wherein said values are a function of the carrier frequency and phase offsets to be estimated; and
- (d) processing said values to determine estimates of the carrier frequency and phase offsets.

2. (Original) The method of claim 1 further comprising:

- (e) initializing the parameters of a Phase-Locked Loop with the estimated carrier frequency and the phase offsets.

3. (Original) The method of claim 1 wherein step (c) uses an unwrap phase function to derive said set of values.

X 4. (Original) The method of claim 1 wherein the processing of step (d) uses an estimation algorithm based on the recursive least-squares method.

X 5. (Original) The method of claim 1 wherein the processing of step (d) uses an estimation algorithm based on the Kalman filtering method.

X 6. (Original) The method of claim 1 wherein the processing of step (d) uses an estimation algorithm based on the least-mean squares method.

X 7. (Original) A method for recovering a carrier phase offset and a carrier frequency offset comprising the steps of:

- (a) receiving a modulated signal containing a plurality of symbols;
- (b) determining an angular location of first symbol;
- (c) determining an angular location of a second symbol;
- (d) removing the modulation from the second symbol to produce an unmodulated angular sequence; and
- (e) estimating the carrier phase and frequency offsets by curve fitting the unmodulated angular sequence.

X 8. (Original) The method described in claim 7 further comprising the step of:
(f) unwrapping the unmodulated angular sequence to compensate for phase discontinuities.

4 9. (Currently Amended) The method of claim 7 wherein step (f) (e) is based on the recursive least-squares method to perform the curve-fitting.

5 10. (Currently Amended) The method of claim 7 wherein step (f) (e) is based on the Kalman filtering method to perform the curve-fitting.

6 11. (Currently Amended) The method of claim 7 wherein step (f) (e) is based on the least-mean squares method to perform the curve-fitting.

2 12. (Original) The method of claim 7 wherein the carrier phase offset and the carrier frequency offset are used as initialization parameters in a phase-locked loop.

13. Canceled.

14. (Currently Amended) ~~The apparatus of claim 13 further comprising:~~ An apparatus for estimating a carrier phase offset and a carrier frequency offset, comprising:

- (a) a phase calculator for estimating phases of a sequence of digitally modulated symbols;
- (b) a remove modulation module for removing an angle rotation introduced by a modulation format to generate a sequence of phase values representative of the carrier frequency offset and the carrier phase offset;
- (c) an estimation module for estimating the carrier frequency offset and the carrier phase offset, whereby the estimation module applies a curve-fitting algorithm to the sequence of phase values to generate a linear function dependent of the carrier frequency offset and the carrier phase offset; and
- (d) an unwrap module for converting the phase estimates generated by the phase calculator module into absolute values.

15. (Currently Amended) The apparatus of claim ~~13~~ 14, further coupled to a phase-locked loop to initialize the phase-locked loop with the estimates of the carrier frequency offset and the carrier phase offset.

16. (Currently Amended) The apparatus of claim ~~13~~ 14, wherein the estimation module applies a curve-fitting algorithm to the sequence of phase values to estimate the carrier frequency offset and the carrier phase offset.